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AN INTERFACE BOARD FOR MONITORING THE OPERATIONAL STATUS OF A L--ETC(U)
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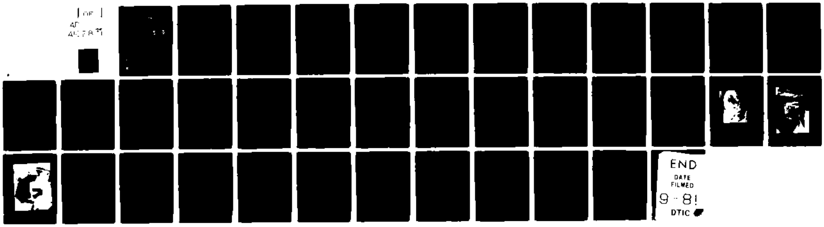

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SUMMARY

The design of a computer interface board is described, which monitors and controls the operational status of a modified Linoscan 204 scanner/generator, used in the production of photographic images from data stored on computer compatible tapes.

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1 INTRODUCTION

The UK National Point of Contact (NPOC) with the European Space Agency's Earthnet organisation is a centre operated by the Remote Sensing Unit (RSU) of Space Department, RAE Farnborough. One of its main functions is to produce photographic images (Fig 1) from remote sensing spacecraft data, such as Landsat[1] provides using a Linoscan 204 film-writing machine[2]. The spacecraft data are stored on computer compatible tapes (CCT) and are read by a PRIME 200 digital computer before transmission to the Linoscan machine. Here the data are converted to analogue signals, which are used to control cold cathode crater tubes. The light emitted by these is passed through precision optical systems to expose photographic film to produce monochrome negatives.

The interface unit described provides two-way communication between the Linoscan and the computer, enabling an operator to check that all initial conditions are established correctly prior to commencing film production. In this way, operator errors are reduced and repeatability of output products is maintained. This reduction of errors and improvement in quality is very important to the efficient operation of the NPOC and of the associated UK RSU, because the available photographic facilities are always under pressure to increase output. Consequently, any procedures which reduce wasted effort are beneficial.

2 SOURCES OF IMAGE DATA

The RSU is called upon to produce images derived from many different spacecraft and sensors. These include the following:

(i) Seasat A. Synthetic aperture radar images generated by digital processing at the RAE of the data transmitted to the ground station at RAE Oakhanger.

(ii) Meteosat. Images of the whole earth, or of sectors, in the visible, infra-red, and water vapour emission regions of the spectrum. The data employed are acquired by the ground station at RAE Lasham.

(iii) Tiros-N and NOAA-6. Images in the visible ana infra-red regions of the spectrum derived from the Advanced Very High Resolution Radiometers carried by these meteorological spacecraft. The data used are acquired by the Lasham ground station.

(iv) Nimbus-7. Images produced by the Coastal Zone Colour Scanner and acquired by the Earthet station at Lannion.

(v) Heat Capacity Mapping Mission Spacecraft. Data acquired at Lannion from this spacecraft by both day and night are used to generate images for thermal analysis.

Despite this variety, the bulk of the image generation and processing is from Landsat data, so a more complete description will be given of these spacecraft and of the sensors carried by them. The Landsat satellites[1] are a series of remote sensing spacecraft launched to survey the earth, from a typical height of 920 km. They are injected into polar orbits with a longitudinal image swath from 81°S to 81°N. The ground path of each satellite is repeated to within 37 km every 18 days (251 revolutions). The spacecraft carry on board two remote sensing systems:

(1) a Multi-Spectral Scanner (MSS)

(2) a Return Beam Vidicon (RBV) sensor.

The MSS scans the earth over a 185km wide swath and collects data simultaneously in four spectral bands, covering the range from 0.5-1.1 microns, with a spatial resolution, based on picture elements, or pixels, of 80 metres x 60 metres.

The RBV system in Landsat 3 views the same swath as the MSS, but covers overlapping adjacent areas about 98 km square (four RBV scenes will normally fill each MSS frame). The RBV system consists of two panchromatic cameras operating in the 0.50-0.75 micron spectral band.

The data are transmitted to the ground in analogue form, via an S-band data link (2.2 GHz), where they are sampled, digitised and recorded on magnetic tape for subsequent processing and production of images. The sampling rate corresponds to a pixel size of 1 m square.

3 THE LINOSCAN MACHINE

The machine used in the production of Landsat and other spacecraft imagery is a modified Linoscan 204 scanner, which can function either as an 'INPUT' or an 'OUTPUT' device. In the 'INPUT' mode, transparencies to be 'READ' are mounted on a tranparent drum (Fig 2) whilst in the 'OUTPUT' or 'WRITE' mode, films to be exposed are mounted on an opaque drum (Fig 3). Both drums are connected by a common shaft and belt driven using a synchronous motor.

When 'WRITING', digital data stored on CCTs are processed by the computer and transmitted to the Linoscan machine (Fig 4). The data are converted to analogue form and used to modulate the brightness of a cold cathode tube, whose light output is passed through an optical system of lenses and filters and is focussed on to the film to be exposed. As the film rotates in front of the lamp, so a thin line, varying in intensity, will be 'WRITTEN' on the film.

The optical system is mounted on a carriage which is driven by a lead screw, and as the latter rotates, a 'helix' of light traverses and exposes the complete film.

Films to be 'READ' are mounted on the transparent drum and illuminated by a small halogen lamp mounted within the drum. As the latter rotates, the film is scanned by a thin pencil of light which spirals around the film as the lamp moves transversely along the drum.

The light transmitted through the film is received by a system of prisms and filters which separate it into three spectral bands plus a black/white channel. These provide inputs to photomultiplier tubes, the electrical outputs of which are digitised, prior to being processed by the computer and subsequently recorded on CCTs.

4 THE COMPUTER INTERFACE

4.1 General description

Data transfers to and from the Linoscan machine are controlled and coordinated by a PRIME series 200 computer, using a General Purpose Interface Board (GPIB)[3], Fig 4.

This is a standard piece of hardware provided by the computer manufacturer to allow interfacing with non-standard devices, and consists of a system of dual in-line packages (DIPs) mounted on a universal pin connector grid contained within a standard computer module.

Functionally, the GPIB contains two discrete sections:

(a) A prefabricated and tested logic system which provides the user with appropriate data and timing signals, details of which are given in Ref 3.

(b) Special-to-purpose interface logic designed by the user (SPIB).

4.2 Special-to-purpose interface (SPIB)

4.2.1 General operation

The function of the SPIB is to provide two-way communication between the Linoscan machine and the computer, thereby enabling the operator to check, and if necessary, modify the operational status prior to commencing film production.

A block schematic of the data highways is shown in Fig 5.

Status data regarding bit rate, scan rate etc are loaded into the data buffers via a control pulse, which is generated by an OCP computer instruction. The buffers are interrogated by an 'input to A register' (INA) instruction which enables the data to be processed by the computer and printed subsequently on a teletype machine. When the information has been checked and verified, the operator sends a GO instruction and film READ/WRITE commences.

The computer program for implementing these instructions, ARTH1, is described in Appendix A, and the actual program is detailed in Appendix B.

4.2.2 Detailed operation

Fig 6 shows the circuit configuration for controlling the flow of data.

Initially the computer generates the SYSCL signal which is applied subsequently to the CLEAR input, Pin 1, of FLIP/FLOP 47E, setting its 'Q' output, Pin 5, to a logic '0'. The output of NAND gate, 41E, assumes a logic '1' level which, via the OR gate comprising units 39E and 45E, drives the READY line positive. Thus all data transfers on the computer bus are inhibited.

To commence data transfers, the computer acknowledges the reception of an INA instruction and transmits signals PIOXX, INAXX and DFOOXX. Device address signals DADO6 and DAD60, after inversion, are combined in NAND gate 37E to produce the UDADOK signal, which when asserted (logic '0') connects the READY line to the computer INPUT/OUTPUT bus.

The generation of control pulse OCP1766 (Fig 7) sets the 'Q' output of FLIP/FLOP 47E, pin 5, to a logic '1' and simultaneously loads Linoscan information into the data registers D and E (Fig 8).

The action of setting FLIP/FLOP 47E, enables the NAND gate 41E, which in turn drives the READY line negative, notifying the computer that the SPIB is ready to transfer

data stored in registers D and E. When data transfers have been completed, the computer supplies a STROB pulse which resets FLIP/FLOP 47E, terminating the INA instruction.

Further data transfers may be executed by generating DATA STROB which enables the whole sequence to be repeated.

[illegible] LINOSCAN STATUS DATA

The Linoscan data points to be monitored are described in the following sections.

[illegible] Bit rate monitor

To accommodate the various data rates from the remote sensing spacecraft, three thumbwheel switches are provided on the Linoscan, which can be programmed from [illegible] kilo bits/second (KBPs). The outputs of the switches, 000-999 in Binary Coded Decimal (BCD) at TTL compatible logic levels, are fed into a BCD to binary converter (units [illegible]F, 20F, 18F, [illegible]F, [illegible]F, 12F) via inverters 10F, 8F (Fig 9). The converted outputs are applied to the user data registers (Fig 8) along the data lines DATA 01+ to DATA 10+.

[illegible] Drum speed monitor

To control the drum speed, a switch is located on the front panel, having two positions FAST/SLOW. When in the FAST position, a +5 volt signal is applied to the terminal shown (Fig 1[illegible]), and when in the SLOW position 0 volt is applied. These voltages are applied to the interface board where, after inversion, they are transferred to the user data registers on line DATA [illegible]+ (Fig 8).

[illegible] The [illegible] switch monitor

The FINE/COARSE switch which varies the pitch of the helix between two fixed settings, is located adjacent to the drum speed switch on the front panel. When in the [illegible] position, a + [illegible] signal is available (Fig 1[illegible]), which is applied to a MLM 309K voltage regulator to provide an output voltage compatible with TTL logic. The regulator is mounted in an aluminium diecast box, adjacent to the switch terminals at the back of the panel. The regulator produces an output voltage of '+5 volts' when the switch is in the [illegible] position and '[illegible] volts' in the COARSE position. These signals are applied to the data registers on line DATA [illegible]+ (Fig 8).

[illegible] Drum index monitor

The drum index is the name given to two parallel push button switches. One is [illegible] on the front panel adjacent to the FAST/SLOW and FINE/COARSE switches, whilst the other is located adjacent to the revolving drum. When depressed, either switch will prevent the drum from rotating. It is important to monitor these switches since, when the Linoscan is operational, the machine is light-tight and hence there is no indication as to whether the internal switch is depressed or not. To monitor the status of the switch, a full wave rectified voltage, peak amplitude 18 volts, is available. This voltage is smoothed by two [illegible] μF and a 0.22 μF capacitors, connected in parallel (Fig 10) and is fed to a MLM 309K voltage regulator. The resultant output voltage (+5 volts when drum index is ON) is fed along the line DATA 13+ to the user data register (Fig 8).

The capacitors and voltage regulator are mounted in the same diecast aluminium box as the components for the FINE/COARSE switch monitor.

5.5 Carriage return monitor

The carriage contains the lights which are used to expose the films. The carriage status is an important factor to monitor, because if it has not been returned fully to its initial position prior to the commencement of writing a film, only a portion of the film will be exposed. The monitor point for identifying the carriage position is a micro-switch, which is connected to a '+5 volt' source when in the forward position, and '0 volt' when in the start position. The switch voltage is inverted, before entering the data register on input line DATA 14+ (Fig 8).

5.6 Lamp monitors

There are four lamps mounted on the carriage, of which 1 and 3 are used for the generation of images. In the event of the lamps being left on permanently, in which case their lifetime is shortened considerably, or not being switched on initially, when no negative is produced, the mistake is not discovered until much later, after the negatives have been processed.

The connections made to the terminals of the lamp switches are shown in Fig 11. The voltage on these terminals is '+24 volt' dc when in the OFF position and '0 volt' when in the ON position. To provide compatible logic levels, the voltage is regulated by a μA 7[illegible] dc voltage regulator to produce 0 to +5 volts. The regulator output is then inverted to produce an output voltage of '+5 volts' when the lamp is ON and '0 volt' when OFF. The output is fed into the data registers along lines: DATA 15+ for lamp 1, DATA 16+ for lamp 3 (Fig 8).

CONCLUSIONS

A computer interface has been designed and programs have been written which enable an operator to communicate with a Linoscan machine under computer control. Using a 'question and answer' technique, the computer awaits confirmation of correct operational status before allowing film READ/WRITE procedures to commence. Thus operator errors are reduced considerably, resulting in increased productivity.

Acknowledgments

The author wishes to thank Mr L. Smith, Mr A. O'Dell and Mr G. White for many helpful discussions.

Appendix A

A DESCRIPTION OF THE USE OF THE ARTH PROGRAM, WITH A TYPICAL TELETYPE OUTPUT

A.1 Introduction

This Memorandum is an introduction to the use of the ARTH program on the Linoscan diskette.

A.2 Start-up procedure

After switching ON the computer and its associated peripherals, the following set of instructions should be executed.

A.2.1 Insert diskette marked Linoscan in drive 1

The drive number is on a thumbwheel above each drive. Usually the left-hand drive thumbwheel shows '2' and the right-hand one '1'. The drive labelled '1' is diskette drive 20, and the one labelled '2' is drive 21. The diskette must be inserted with the label outermost and facing to the right.

A.2.2 Set sense switches 14 and 15 in the UP position

The sense switches at the front of the computer are numbered 1-16, from left to right. Each switch has three positions 'level', 'up' and 'down'. Each sense switch will stay in the 'up' and 'level' positions but is spring loaded to return from the 'down' to the 'level' positions when depressed. For this step sense switches 14 and 15 should be in the 'up' position and all others in the 'level' position.

A.2.3 Set the rotary switch to STOP/STEP

The rotary switch is on the right-hand side of the computer control panel, and has seven positions. The STOP light above the rotary switch is illuminated whenever the rotary switch is set to STOP/STEP.

A.2.4 Press and release MASTER CLEAR

The MASTER CLEAR sense switch is situated on the left-hand side of the computer panel, and is spring biased.

A.2.5 Set the rotary switch to LOAD

A.2.6 Press and release START sense switch

The START switch is adjacent to the rotary switch. It will return on a spring when released. The text 'PHYSICAL DEV =' will be typed by the computer on the teletype. This message indicates that the computer is requesting a number from which to load the operating system. As you have put the Linoscan diskette in drive '1' the device number is 20.

Refer to the following example.

A.2.7 Type 20 followed by carriage return (CR)

When you type this on the teletype the system will be loaded and will print:

PRECEDING PAGE BLANK-NOT FILMED

PRIMOS II REV 14 09/26/77 (AT 070000)

followed by:

OK:

A.2.8 Turn the rotary switch to RUN

which can be done at any time after the START key has been depressed.

A.2.9 Type STARTUP 20 followed by (CR)

whence the system will type:

OK:

A.3 <u>Type in ARTH1</u>

This will start the program for checking the setting on the Linoscan, and will then print the following:

GO

IS THIS YOUR FIRST RUN.

You type in 'YES' or 'NO'. Answering this question will decide whether you want to set up the initial conditions or use the conditions set for the last band.

If it is your first run, after you have typed in 'YES' the teletype will print:

TYPE IN THE BIT RATE PLEASE.

You type in: '[illegible]' or '[illegible]' (for example) followed by (CR). The teletype then prints:

YOU TYPED IN 436 IS THIS CORRECT,

to which you reply 'YES' or 'NO' (CR). If it is incorrect and you wish to change it, having answered 'NO', the teletype will print:

THEN TYPE IN THE CORRECT ONE NOW.

Then you can alter the input conditions. If 'NO' is answered to any of the questions asked in this stage of the program, the above print out will be written. The correct data is then entered followed by (CR).

Having input the data for the bit rate and checked it the teletype will print:

DRUM SPEED? - FAST=FAS, SLOW=SLO.

You type in 'FAS' or 'SLO' (CR).

The computer then asks you if what you have just typed in is correct, and now you can change it or not.

Next the teletype will print:

COARSE OR FINE? - FINE=FIN, COARSE=COS

You reply, then follow it by (CR).

It checks your answer, then the teletype will print:

WHICH LAMP(S) DO YOU REQUIRE?

TYPE IN NO1 FOR LAMP 1, NO3 FOR LAMP 3, 1&3 FOR BOTH LAMPS

You answer this question, the computer checks it with you, then depending on the answers you give, the terminal will type:

ARE YOU READY?

You answer 'YES' or 'NO'. If 'YES' the computer will then check all the settings on the Linoscan with what has been input. It will also check the mandatory switches, eg Drum Index and Carriage Return.

If a fault is found, the teletype will print a message:

eg, THE DRUM INDEX IS ON WHEN YOU HAVE CORRECTED THE SWITCHES PRESS RETURN

After correcting the switch the computer will then check all the settings again, and if another error has occurred a further message will be printed. ONLY when ALL switches are set correctly will the teletype print:

ALL THE SETTINGS HAVE BEEN CHECKED AND ARE CORRECT

After a pause it will print:

****ST

OK:

The computer is now back in the operating system, and ready for use.

When the program is run again for the next band and the teletype prints:

IS THIS YOUR FIRST BAND

you can answer 'NO' to which the teletype will print out what your current settings are and ask you if you want them changed:

eg,

YOUR SETTINGS ARE

BIT RATE [illegible]

DRUM SPEED SLO

C/F SWITCH FIN

LAMPS [illegible]

DO YOU WANT THEM CHANGED

If you want to change them answer 'YES', then the computer will ask you what new bit rate etc you want.

If you want to keep them answer 'NO' then the teletype will print:

ARE YOU READY?

to which you answer 'YES' or 'NO'. After answering this question the computer will then check the settings on the Linoscan and print out an error message, if one is found.

See example on the following pages.

```
PHYSICAL DEV=0

PRIMOS II REV [illegible] (AT 070000)

OK: STARTUP 0
OK: ARTHT
NO
IS THIS YOUR FIRST RANK
YES
TYPE IN THE BIT RATE PLEASE
[illegible]
YOU TYPED IN [illegible] IS THIS CORRECT?
YES
DRUM SPEED? - FAST=FAS, SLOW=SLO
FAS
YOU TYPED IN FAS IS THIS CORRECT?
NO
THEN TYPE IN THE CORRECT ONE NOW
SLO
COARSE OR FINE? - FINE=FIN, COARSE=COS
COS
YOU TYPED IN COS IS THIS CORRECT?
YES
WHICH LAMP(S) DO YOU REQUIRE?
TYPE IN NO [illegible] FOR LAMP [illegible], NO [illegible] FOR LAMP [illegible], [illegible] FOR BOTH LAMPS
[illegible]
YOU TYPED IN [illegible] IS THIS CORRECT?
YES
ARE YOU READY?
NO
OK THEN.PRESS RETURN WHEN YOU ARE READY

ALL THE SETTINGS HAVE BEEN CHECKED AND ARE CORRECT

****ST

OK: ARTHT
NO
IS THIS YOUR FIRST RANK
NO
YOUR SETTINGS ARE
BIT RATE [illegible]
DRUM SPEED SLO
C/F SWITCH COS
LAMPS [illegible]
DO YOU WANT THEM CHANGED?
NO
ARE YOU READY?
YES
ALL THE SETTINGS HAVE BEEN CHECKED AND ARE CORRECT

****[illegible]

OK: ARTHT
NO
IS THIS YOUR FIRST RANK
NO
YOUR SETTINGS ARE
BIT RATE [illegible]
DRUM SPEED SLO
C/F SWITCH COS
LAMPS [illegible]
DO YOU WANT THEM CHANGED?
YES
TYPE IN THE BIT RATE PLEASE
```

Appendix A

```
123
YOU TYPED IN 123 IS THIS CORRECT?
YES
DRUM SPEED? - FAST=FAS, SLOW=SLO

ETC
```

Appendix B

THE ARTH1 PROGRAM

```
C   THIS PROGRAM CHECKS THE CORRECT SETTING OF THE SWITCHES ON THE LINOSCAN
C
C   INPUT DATA FROM OPERATOR
$INSERT SYSCOM>A$KEYS
      LOGICAL OK
      REAL JAA,JBB,JCC,BJ,BI,CH
      INTEGER J,VB,GH,S,SI,SII,JX,Z,JA,JB,JC
      CALL ATCH$$('LINO', 4, :100000, 6H         1, ICODE)
      JX=0
      Z=0
   73 WRITE(1,55)
   55 FORMAT('IS THIS YOUR FIRST BAND')
      READ(1,56) GB
   56 FORMAT(1A2)
      IF(GB EQ 'YE') GOTO 54
      IF(GB EQ 'NO') GOTO 71
      CALL FINAL
      GOTO 73
   71 CALL PORCHE(J,JAA,JBB,JCC,AUS,JA,JB,JC)
      IF(AUS EQ 'NO') GOTO 72
   54 CONTINUE
      WRITE(1,1)
    1 FORMAT('TYPE IN THE BIT RATE PLEASE')
      READ(1,400) J
  400 FORMAT(I3)
      VB=J
      CALL PAIN(VB,GH,JX)
      J=GH
      S=0
   60 WRITE(1,2)
    2 FORMAT('DRUM SPEED? - FAST=FAS ,SLOW=SLO')
      READ(1,100) JAA
  100 FORMAT(1A3)
      CALL ANSER(S,JAA,Z)
      IF(Z EQ 0) GOTO 81
      IF(S GT 0) GOTO 60
   81 CONTINUE
      BJ=JAA
      CALL CHECK(BI,BJ,JX)
      JAA=BI
      CALL ANSER(S,JAA,Z)
      IF(Z EQ 0) GOTO 82
      IF(S GT 0) GOTO 60
   82 CONTINUE
      JAA=BI
      IF(JAA EQ 'FAS') JA=0
      IF(JAA EQ 'SLO') JA=1
      SI=0
   61 WRITE(1,3)
    3 FORMAT('COARSE OR FINE?- FINE=FIN,COARSE=COS')
      READ(1,200) JBB
  200 FORMAT(1A3)
      CALL ANSERI(SI,JBB,Z)
      IF(Z EQ 0) GOTO 83
      IF(SI GT 0) GOTO 61
   83 CONTINUE
      BJ=JBB
      CALL CHECK(BI,BJ,JX)
      JBB=BI
```

```
      CALL ANSERI(SI,JBB,Z)
      IF(Z EQ 0) GOTO 84
      IF(SI GT 0) GOTO 61
   84 CONTINUE
      JBB=BI
      IF(JBB EQ 'FIN') JB=1
      IF(JBB EQ 'COS') JB=0
      SII=0
   62 WRITE(1,4)
    4 FORMAT('WHICH LAMP(S) DO YOU REQUIRE?'/
     1'TYPE IN NO1 FOR LAMP 1,NO3 FOR LAMP 3,1&3 FOR BOTH LAMPS')
      READ(1,300) JCC
  300 FORMAT(1A3)
      CALL ANERII(SII,JCC,Z)
      IF(Z EQ 0) GOTO 85
      IF(SII GT 0) GOTO 62
   85 CONTINUE
      BJ=JCC
      CALL CHECK(BI,BJ,JX)
      JCC=BI
      CALL ANERII(SII,JCC,Z)
      IF(Z EQ 0) GOTO 86
      IF(SII GT 0) GOTO 62
   86 CONTINUE
      JCC=BI
      IF(JCC EQ 'NO1') JC=1
      IF(JCC EQ 'NO3') JC=2
      IF(JCC EQ '1&3') JC=3
      OK=OPEN$A(A$WRIT+A$SAMF,'LINO FILE',9,5)
      IF(OK) GOTO 13131
      WRITE(1,14141)

14141 FORMAT('FAILURE TO OPEN FILE W')
13131 WRITE(9,11111) JA,JB,JC,J,JAA,JBB,JCC
11111 FORMAT(3I1,I3,3A3)
      CALL CLOS$A(5)
   72 CONTINUE
      WRITE(1,5)
    5 FORMAT('ARE YOU READY?')
      READ(1,54321) CH
54321 FORMAT(1A2)
      IF(CH EQ 'YE') GOTO 89
      IF(CH EQ 'NO') GOTO 89
      CALL FINAL
      GOTO 5
   89 IF(CH EQ 'NO') CALL ANSERX
      K=0
   26 CONTINUE
C   READ DATA FROM LINOSCAN
      CALL INTF(I)
      IT=AND(I,1023)
      IP=AND(RS(I,10),1)
      IM=AND(RS(I,11),1)
      IJ=AND(RS(I,12),1)
      IA=AND(RS(I,13),1)
      ID=AND(RS(I,14),3)
C   COMPARE DATA FROM OPERATOR AND LINOSCAN
      IF(IT NE J) GOTO 17
      IF(IP NE JA) GOTO 18
      IF(IM . NE . JB) GOTO 19
```

```
      IF(I EQ 1) GOTO 28
      IF(IA EQ 0) GOTO 21
      IF(JC EQ 3) GOTO 27
      IF(JC NE ID) GOTO 22
      IF(JC EQ ID) GOTO 38
   27 CONTINUE
      IF(ID EQ 0) GOTO 23
      IF(ID EQ 1) GOTO 24
      IF(ID EQ 2) GOTO 25
   38 CONTINUE
C     PRINTOUTS IF ANY INCORRECT SWITCHES
   28 CONTINUE
      WRITE(1,29)
   29 FORMAT('ALL THE SETTINGS HAVE BEEN CHECKED AND ARE CORRECT')
C
C      OUTPUT ROUTINES
C     ****************
C
C
      CALL INCRMT(TX,K,S,SI,SII,JK)
      IF(TX EQ 4) GOTO 40
      IF(TY LT 4) GOTO 41
      IF(SII GT 0) GOTO 41
   40 CONTINUE

      CALL JO

   41 STOP
   16 CONTINUE
      K=K+1
      IF(K EQ 3) GOTO 30
      IF(K EQ 4) GOTO 32
      IF(K EQ 5) GOTO 36
   35 CONTINUE
      WRITE(1,6)
    6 FORMAT('WHEN YOU HAVE CORRECTED THE SWITCHES PRESS RETURN')
      READ(1,*)
      GOTO 20
   17 WRITE(1,7)
    7 FORMAT('THE BIT RATE IS SET WRONG')
      GOTO 16
   18 WRITE(1,8)
    8 FORMAT('THE DRUM SPEED IS SET WRONG')
      GOTO 16
   19 WRITE(1,9)
    9 FORMAT('THE COURSE & FINE SWITCH IS SET WRONG')
      GOTO 16
   20 WRITE(1,10)
   10 FORMAT('THE DRUM INDEX IS ON')
      GOTO 16
   21 WRITE(1,11)
   11 FORMAT('THE CARRIAGE HAS NOT BEEN FULLY RETURNED')
      GOTO 16
   22 CONTINUE
      IF(ID EQ 3) GOTO 34
      IF(ID EQ 0) GOTO 23
      WRITE(1,12)
   12 FORMAT('THE WRONG LAMP IS SWITCHED ON')
      GOTO 16
   24 WRITE(1,30)
```

Appendix B

```
 ?? FORMAT('BOTH LAMPS ARE ON AND NOT JUST ONE
    GOTO 16
 13 WRITE(1,13)
 13 FORMAT('BOTH LAMPS ARE OFF')
    GOTO 16
 14 WRITE(1,14)
 14 FORMAT('ONLY LAMP No1 IS ON')
    GOTO 16
 15 WRITE(1,15)
 15 FORMAT('ONLY LAMP No2 IS ON')
    GOTO 16
 30 WRITE(1,31)
 31 FORMAT('WAKE UP! WE DON'T HAVE TIME TO WASTE ...')
    GOTO 35
 32 WRITE(1,33)
 33 FORMAT('NOT AGAIN!!COME ON YOU CAN DO BETTER!!!!')
    GOTO 35
 36 WRITE(1,37)
 37 FORMAT(/'ARRRRRRRR!!!!!!THIS IS YOUR 5th MISTAKE'
   1 'ARE YOU SURE YOU WORK FOR SMEDELYS????????'
   1 'OR ARE YOU JUST MESSING AROUND??')
    GOTO 35
    END
C
C
    SUBROUTINE JO
$INSERT SYSCOM>A$KEYS
    INTEGER AR0(48),AR1(48),AR2(48),AR3(48),AR4(48),AR5(48),
   1AR6(48),AR7(48)
    LOGICAL OK
    CALL POSTN(INUM,ISET)
    IF(ISET.EQ.1) GOTO 99
    OK=OPEN$A(A$READ+A$SAMF,'[illegible]',[illegible])
    IF(OK) GOTO 3
    WRITE(1,3)
  3 FORMAT('FAILURE TO OPEN FLRNOM')
    GOTO 49
  3 DO 4 I=1,INUM
  4 READ(6,*) [illegible]
    IP=SP*101
    [illegible]
    IPOS=(ISP-1)*[illegible]
    IPOS=IPOS-1
    OK=OPEN$A(A$READ+A$SAMF,'[illegible]',[illegible])
    IF(OK)GOTO1
    WRITE(1,2)
  2 FORMAT('FAILURE TO OPEN ..')
    GOTO99
    IF(IPOS.EQ.0)GOTO10
    DO 11 I=0,IPOS
    READ(5,6) A
  6 FORMAT(A2)
 11 CONTINUE
 10 READ(5,7) AR0
  7 FORMAT(48A2)
    READ(5,7) AR1
    READ(5,7) AR2
    READ(5,7) AR3
    READ(5,7) AR4
    READ(5,7) AR5
```

```
      READ(5,7) AR6
      READ(5,7) AR7
      WRITE(1,8) (AR0(J),J=1,40)
    8 FORMAT(40A2)
      WRITE(1,8) (AR1(J),J=1,40)
      WRITE(1,8) (AR2(J),J=1,40)
      WRITE(1,8) (AR3(J),J=1,40)
      WRITE(1,8) (AR4(J),J=1,40)
      WRITE(1,8) (AR5(J),J=1,40)
      WRITE(1,8) (AR6(J),J=1,40)
      WRITE(1,8) (AR7(J),J=1,40)
   99 CALL CLOS$A(1)
      CALL CLOS$A(2)
      RETURN
      END
C
      SUBROUTINE POSTN(INUM,ISET)
$INSERT SYSCOM>A$KEYS
      LOGICAL OK
      OK=OPEN$A(A$READ+A$SAMF,'LINO POSNUM',11,3)
      IF(OK) GOTO 1
    5 WRITE(1,2)
    2 FORMAT('FAILURE TO OPEN POSNUM')
      ISET=1
      GOTO 99
    1 READ(3,*) INUM
      INUM=INUM+1
      CALL CLOS$A(3)
      OK=OPEN$A(A$WRIT+A$SAMF,'LINO POSNUM',11,3)
      IF(OK)GOTO4
      GOTO5
    4 WRITE(3,3) INUM
    3 FORMAT(I3)
      CALL CLOS$A(3)
      INUM=INUM-1
   99 RETURN
      END
C
      SUBROUTINE INCRMT(TX,K,S,SI,SII,JX)
$INSERT SYSCOM>A$KEYS
      LOGICAL OK
      OK=OPEN$A(A$READ+A$SAMF,'LINO ADON',9,8)
      IF (OK) GOTO 1
    5 WRITE(1,2)
    2 FORMAT('FAILURE TO OPEN ADON')
      IFIX=1
      GOTO 99
    1 READ(8,*) TX
      TX=TX+1
      IF(K.EQ.0) GOTO 9
      IF(K.GT.0) GOTO 8
      IF(S.GT.0) GOTO 8
      IF(SI.GT.0) GOTO 8
      IF(SII.GT.0) GOTO 8
      IF(JX.GT.0) GOTO 8
    8 TX=5
    9 CONTINUE
      IF(TX.LE.5) GOTO 7
    6 TX=2
    7 CONTINUE
```

```
      CALL CLOS$A(4)
      K=OPEN$A(A$WRIT+A$SAMF,'LING ADON',3,4)
      IF(OK) GOTO 4
      GOTO 5
    4 WRITE(8,3) TX
    3 FORMAT(I3)
      CALL CLOS$A(4)
      TX=TX-1
      IF(K LE 0)  RETURN
      TX=3
20000 CONTINUE
   99 RETURN
      END
C
      SUBROUTINE CHECK(BI,BJ,JX)
      REAL YAI,BJ,BI,CHR
      INTEGER JX
      WRITE(1,1)BJ
    1 FORMAT( YOU TYPED IN ',1A3,' IS THIS CORRECT? ')
      READ(1,13) YAI
   13 FORMAT(A2)
      IF(YAI EQ 'NO') GOTO 20
      IF(YAI EQ 'YE') GOTO 30
      JX=JX+1
      WRITE(1,3)
    3 FORMAT('NUT!!!! ANSWER YES OR NO ')
      GOTO 1
   20 WRITE(1,2)
      JX=JX+1
    2 FORMAT( THEN TYPE IN THE CORRECT ONE NOW  ')
      READ(1,100) BI
  100 FORMAT(1A3)
      IF(BI NE BJ) RETURN
      WRITE(1,21)
   21 FORMAT( YOU TYPED THIS IN INITIALLY,IS IT CORRECT NOW ')
      READ(1,22) CHR
   22 FORMAT(1A2)
      IF(CHR EQ 'NO') GOTO 20
      GOTO 26
   30 BI=BJ
   26 RETURN
      END
C
      SUBROUTINE PHIN(VB,GH,JX)
      INTEGER VB,GH,JX
      REAL YAI
      WRITE(1,1) VB
    1 FORMAT( YOU TYPED IN ',I3,' IS THIS CORRECT? ')
      READ(1,13) YAI
   13 FORMAT(A2)
      IF(YAI EQ 'NO') GOTO 20
      IF(YAI EQ 'YE') GOTO 30
      JX=JX+1
      WRITE(1,3)
    3 FORMAT('NUT!!!! ANSWER YES OR NO ')
      GOTO 1
   20 WRITE(1,2)
      JX=JX+1
    2 FORMAT( THEN TYPE IN THE CORRECT ONE NOW
      READ(1,100) CH
```

```
 20 FORMAT(I2)
    IF(GH.NE.VB) RETURN
    WRITE(1,21)
 21 FORMAT('YOU TYPED THIS IN INITIALLY IS IT CORRECT NOW ?')
    READ(1,22) FRP
 22 FORMAT(1A2)
    IF(FRP.EQ.'NO') GOTO 30
    GOTO 25
 30 GH=VB
 25 RETURN
    END
C SUBROUTINES TO CHECK VALID ANSWERS
C
    SUBROUTINE ANSER(S,JAA,Z)
    INTEGER S,Z
    REAL JAA
    IF(JAA.EQ.'FAS') Z=0
    IF(JAA.EQ.'FAS') RETURN
    IF(JAA.EQ.'SLO') Z=0
    IF(JAA.EQ.'SLO') RETURN
    Z=Z+1
    S=S+1
    CALL FINAL
    RETURN
    END
C
    SUBROUTINE ANSERI(SI,JBB,Z)
    INTEGER SI,Z
    REAL JBB
    IF(JBB.EQ.'FIN') Z=0
    IF(JBB.EQ.'FIN') RETURN
    IF(JBB.EQ.'COS') Z=0
    IF(JBB.EQ.'COS') RETURN
    Z=Z+1
    SI=SI+1
    CALL FINAL
    RETURN
    END
C
    SUBROUTINE ANERII(SII,JCC,Z)
    INTEGER SII,Z
    REAL JCC
    IF(JCC.EQ.'NO1') Z=0
    IF(JCC.EQ.'NO1') RETURN
    IF(JCC.EQ.'NO3') Z=0
    IF(JCC.EQ.'NO3') RETURN
    IF(JCC.EQ.'1&3') Z=0
    IF(JCC.EQ.'1&3') RETURN
    Z=Z+1
    SII=SII+1
    CALL FINAL
    RETURN
    END
C
    SUBROUTINE FINAL
    WRITE(1,1)
  1 FORMAT('REPLY NOT UNDERSTOOD')
    RETURN
    END
```

```
      SUBROUTINE ANSERX
      WRITE(1,1)
    1 FORMAT('OK THEN PRESS RETURN WHEN YOU ARE READY ')
      READ(1,*)
      RETURN
      END
C
      SUBROUTINE PORCHE(J,JAA,JBB,JCC,AUS,JA,JB,JC)
$INSERT SYSCOM>A$KEYS
      LOGICAL OK
      REAL JAA,JBB,JCC,AUS
      INTEGER J,JA,JB,JC
      OK=OPEN$A(A$READ+A$SAMF,'LINO>FILE',9,5)
      IF(OK) GOTO 13131
      WRITE(1,14141)
14141 FORMAT('FAILURE TO OPEN FILE R')
13131 READ(9,13) JA,JB,JC,J,JAA,JBB,JCC
   13 FORMAT(3I1,I3,3A3)
      CALL CLOS$A(5)
      WRITE(1,1)
    1 FORMAT('YOUR SETTINGS ARE')
      WRITE(1,2) J,JAA,JBB,JCC
    2 FORMAT('BIT RATE ',I3,/,'DRUM SPEED ',A3,/,'C&F SWITCH '
     1,A3,/,'LAMPS ',A3,/,'DO YOU WANT THEM CHANGED ')
      READ(1,9) AUS
    9 FORMAT(1A2)
      RETURN
      END
```

```
      REL
        SUBROUTINE INTF(I)
*             READS A WORD FROM END LINOSCAN INTERFACE
*
      SUBR   INTF
INTF  DAC    **
      OCF     1766
      INA     66
      JMP    *-1
      OTA     1720
      LDA    INTF
      STA*   0,1
      JMP    1,1
      END
```

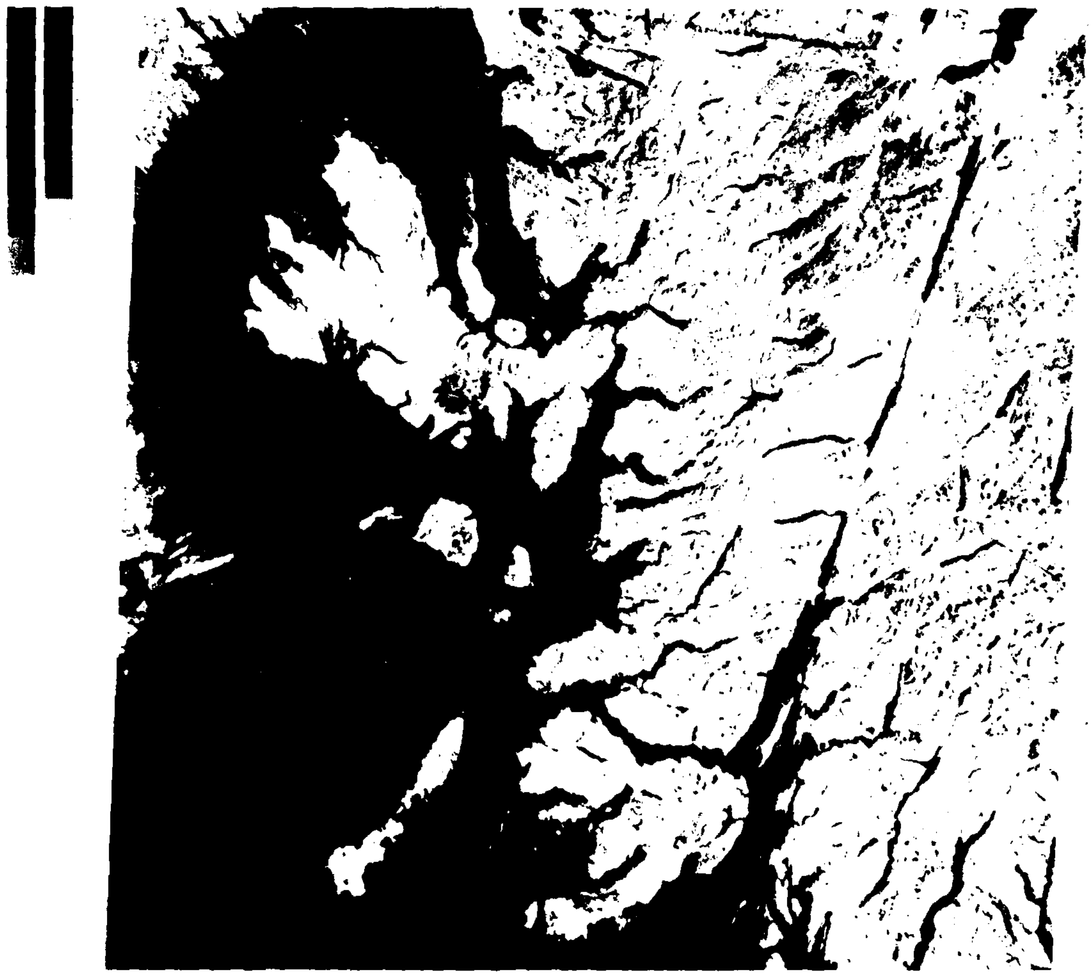
Table 1

CONNECTIONS TO OUTPUT PLUG ON LINOSCAN

PIN	
1	Thumbwheel switch units 1
2	Thumbwheel switch units 2
3	Thumbwheel switch units 3
4	Thumbwheel switch units 4
5	Thumbwheel switch tens 1
6	Thumbwheel switch tens 2
7	Thumbwheel switch tens 3
8	Thumbwheel switch tens 4
9	Thumbwheel switch hundreds 1
10	Thumbwheel switch hundreds 2
11	Thumbwheel switch hundreds 3
12	Thumbwheel switch hundreds 4
13	Fast/slow
14	Fine/coarse
15	Drum index
16	Carriage return
17	Lamp 1
18	Lamp 3
19	N/C
20	Thumbwheel switch common
21 22 23 24 25 26 27 28 29 30 31	Not connected
32	Fast/slow earth
33	Fine/coarse earth
34	Drum index earth
35	Carriage return earth
36	Lamp 1 earth
37	Lamp 3 earth

REFERENCES

No.	Author	Title, etc
1	NASA	Landsat data users handbook, Document No. 76SDS 4258. Goddard Space Flight Centre, September 1976
2	Linotype Paul Ltd	Linoscan 204, Operators guide. Linotype Paul Ltd, Scanner Division, Cheltenham, September 1978.
3	Prime Computer Inc	General purpose interface design guide, Manual 1676. Prime Computer Inc, Massachusetts, November 1976



A typical Landsat image, written using the Linoscan 204.
The region shown is North West Scotland on 31/5/77 in
the infrared region of the spectrum (band 7; 0.7 μm to 1.1 μm)

Fig 1 A typical Landsat photograph

Fig 2 Linoscan machine used in the 'READ' mode

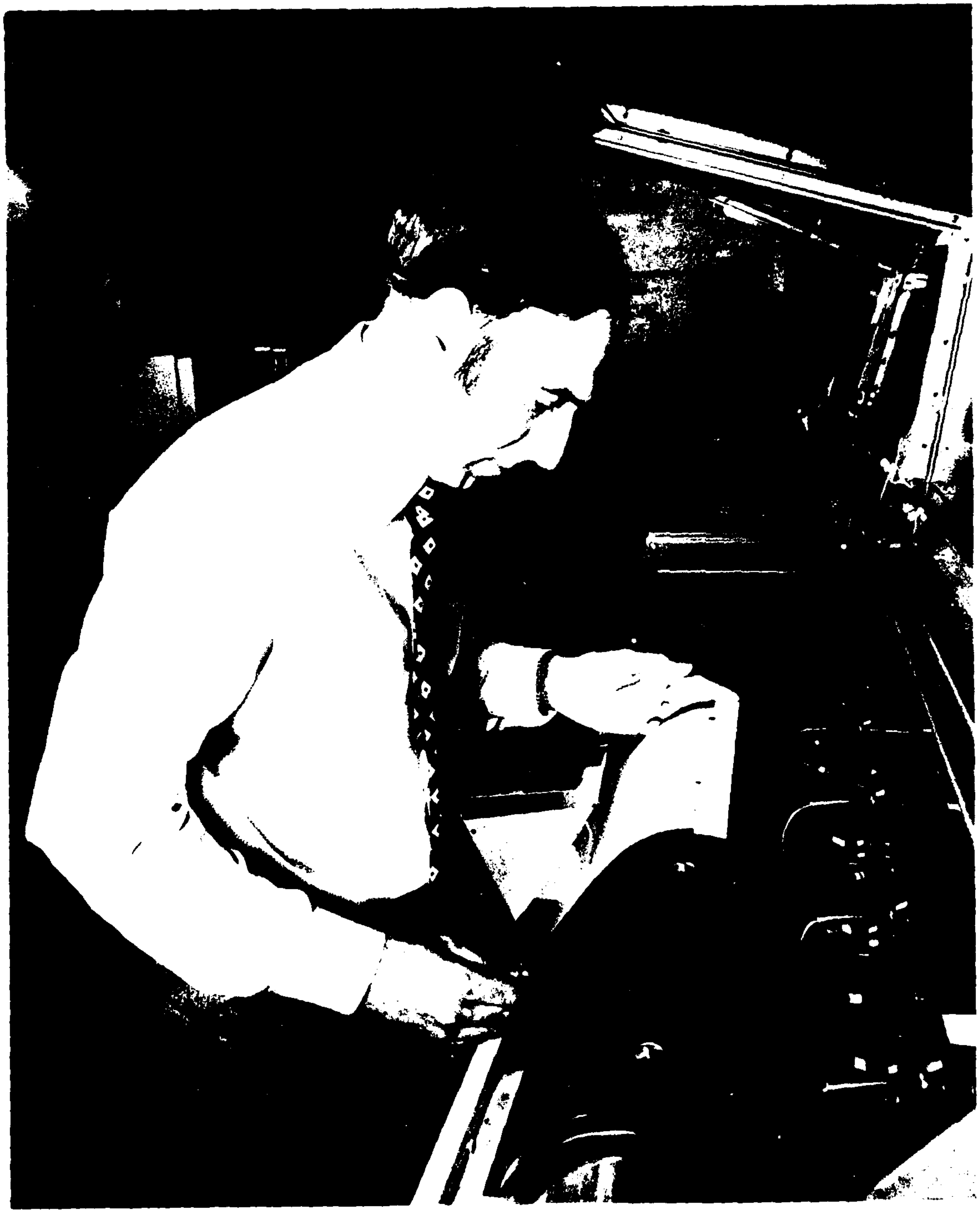


Fig 3 Linoscan machine used in the 'WRITE' mode

Fig 4

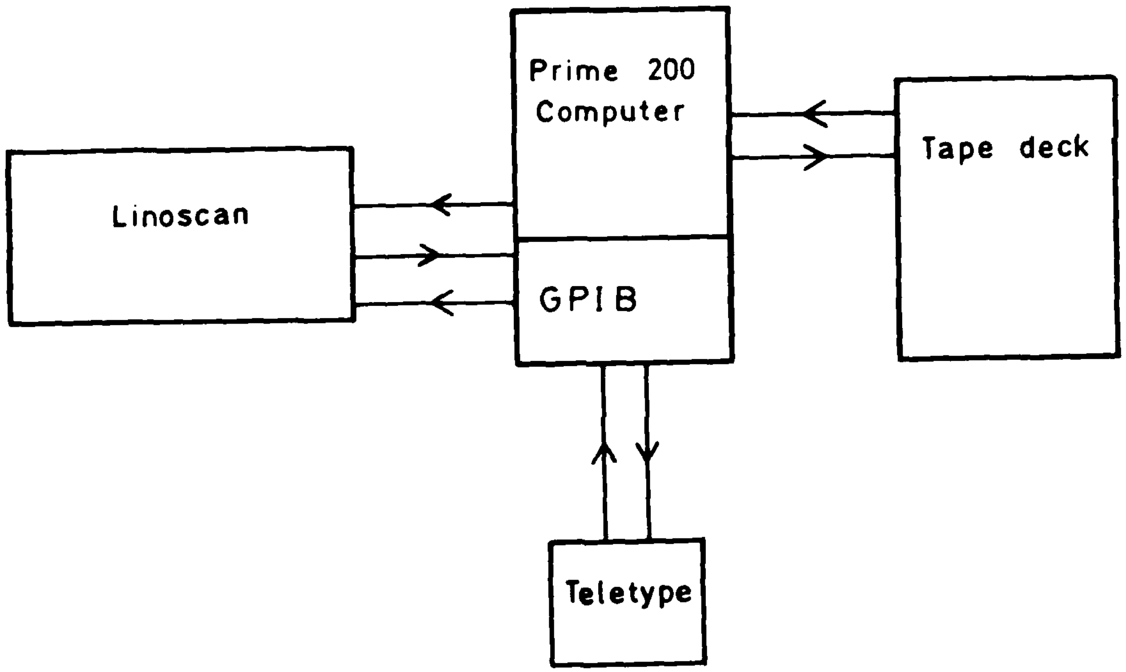


Fig. 4 Block diagram of the system

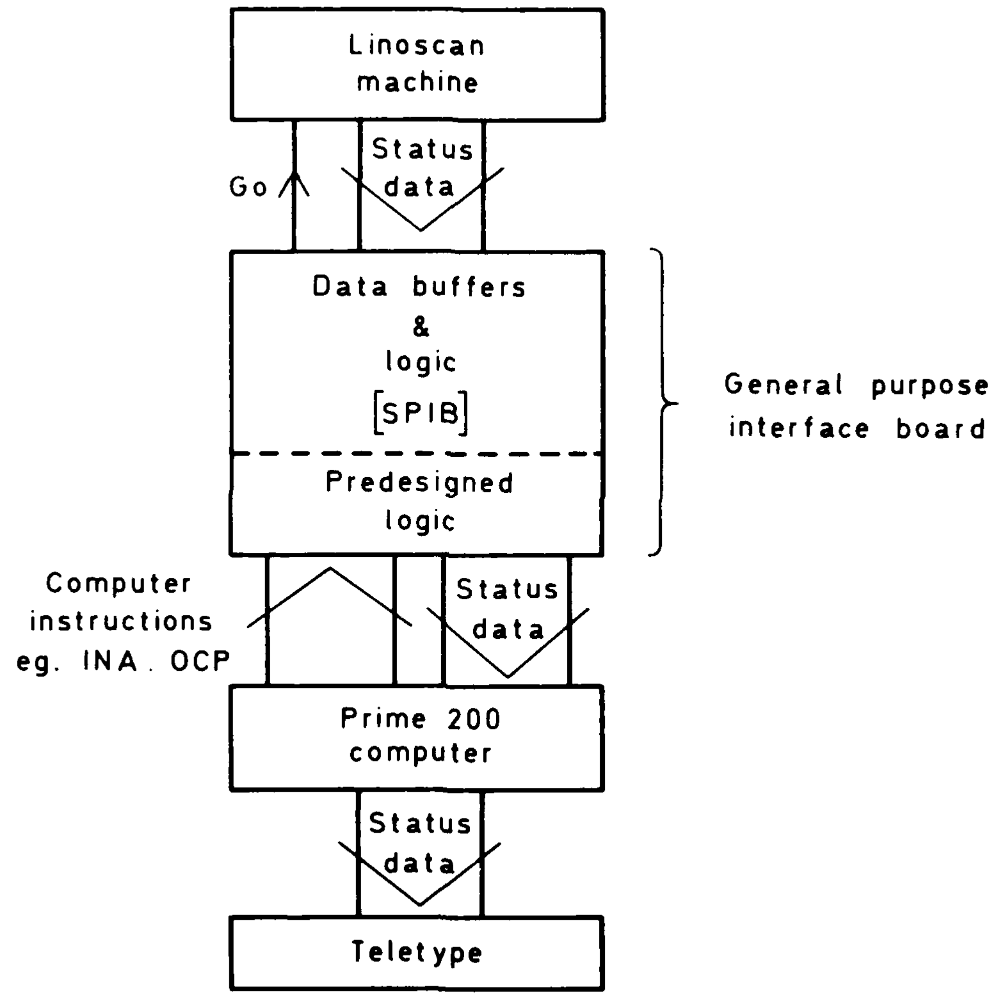


Fig 5 Communication highways between Linoscan and the computer

Fig 6

eg 37E is location of dip on interface board

eg A/7 is line T Fig 7

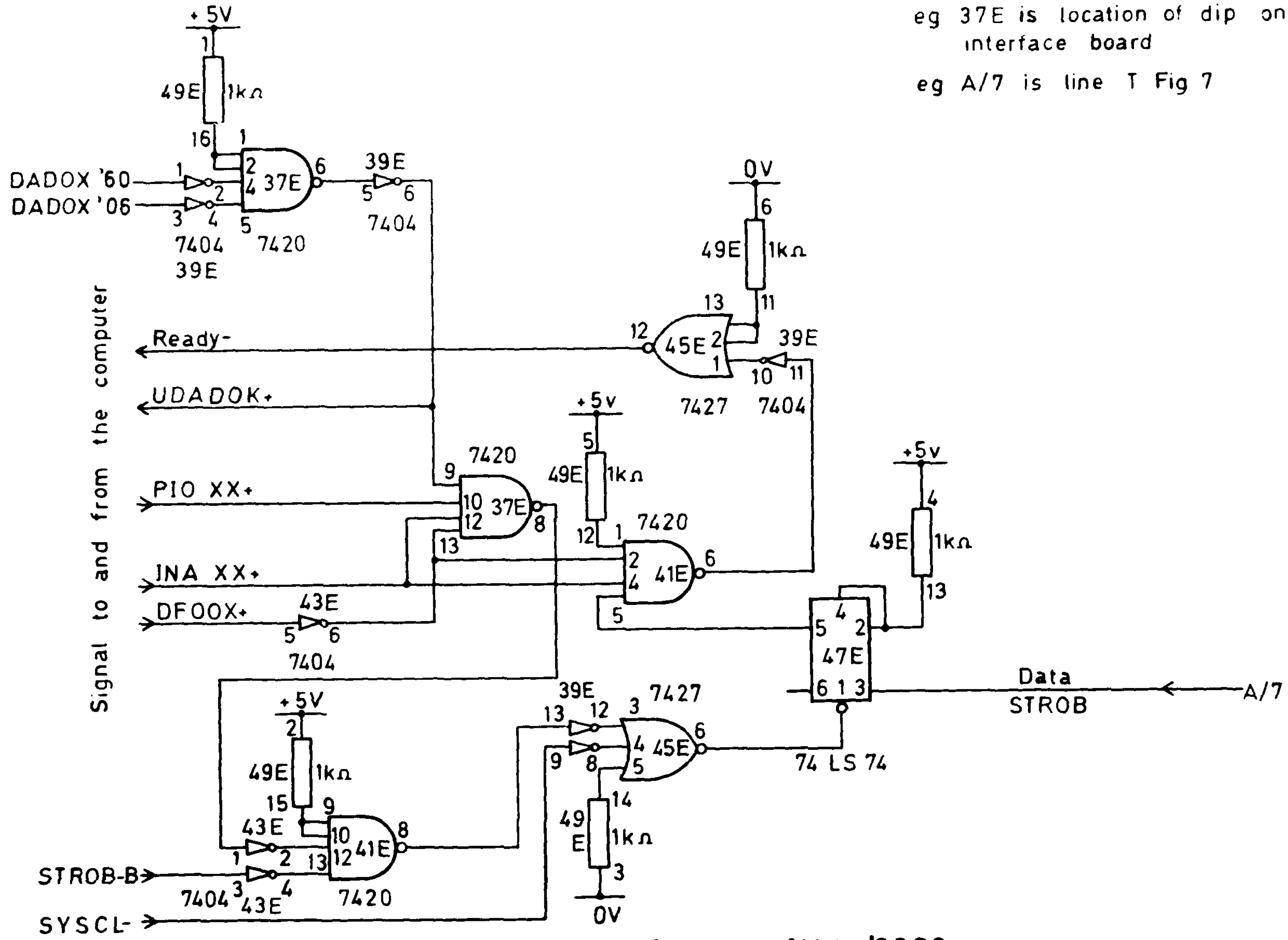


Fig. 6 Generation of INA '0066

eg 12/G location of DIP on interface board

eg A/6 is line A Fig. 6

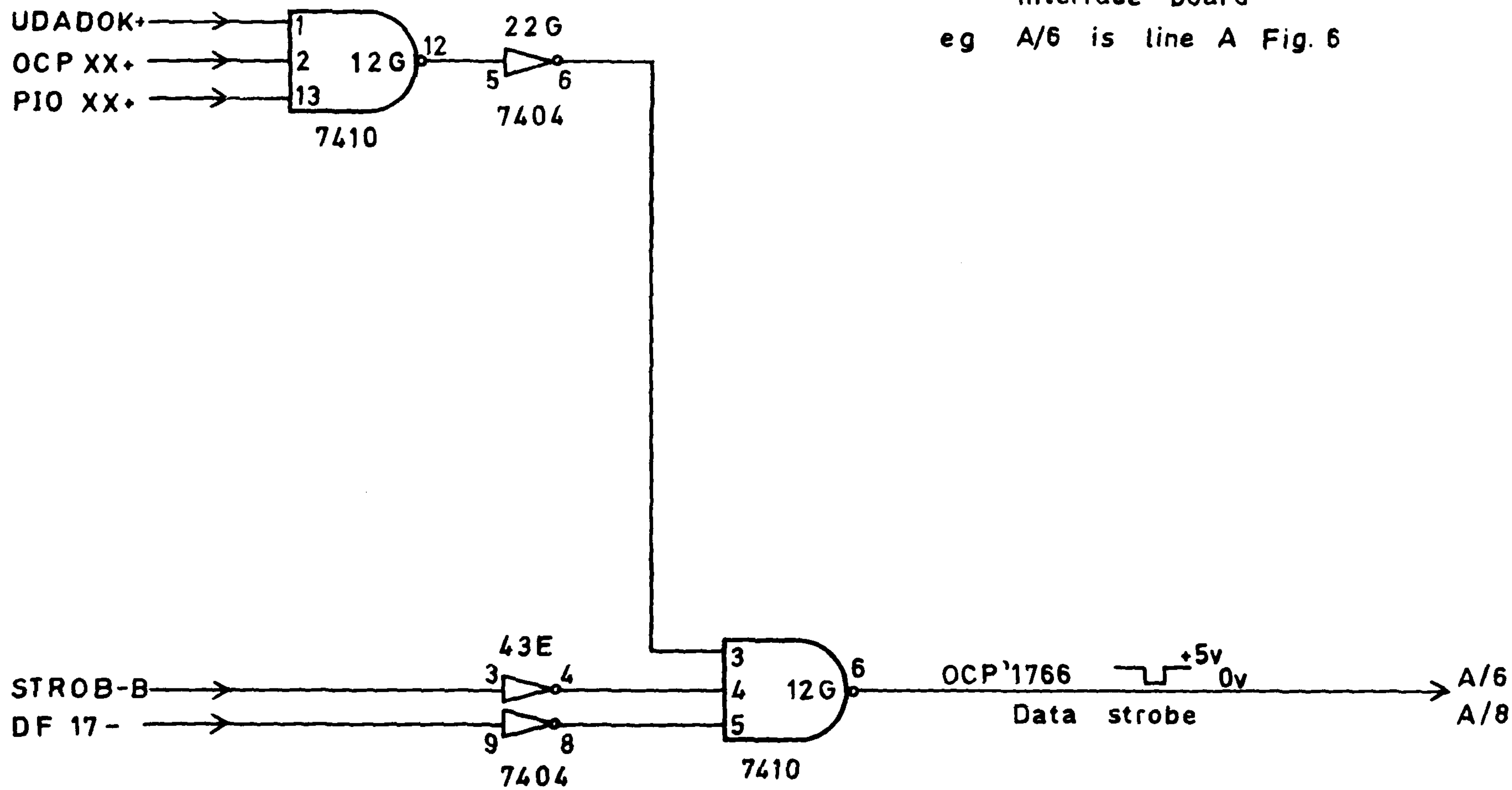


Fig. 7 Generation of OCP '1766

Fig 7

Fig 8

eg Data is location of DIP on interface board

eg Data 04/9 is line Data 04 Fig 9

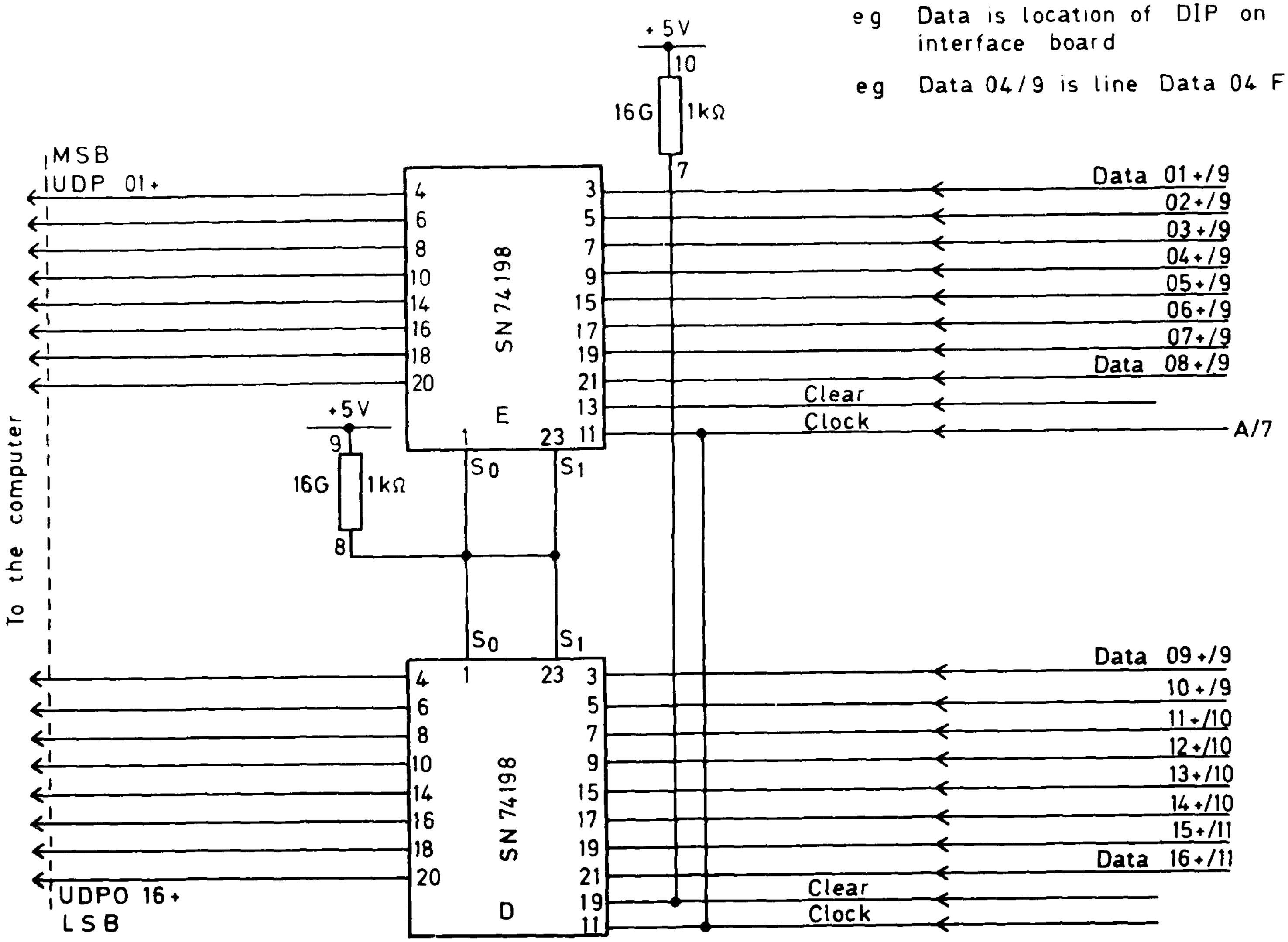
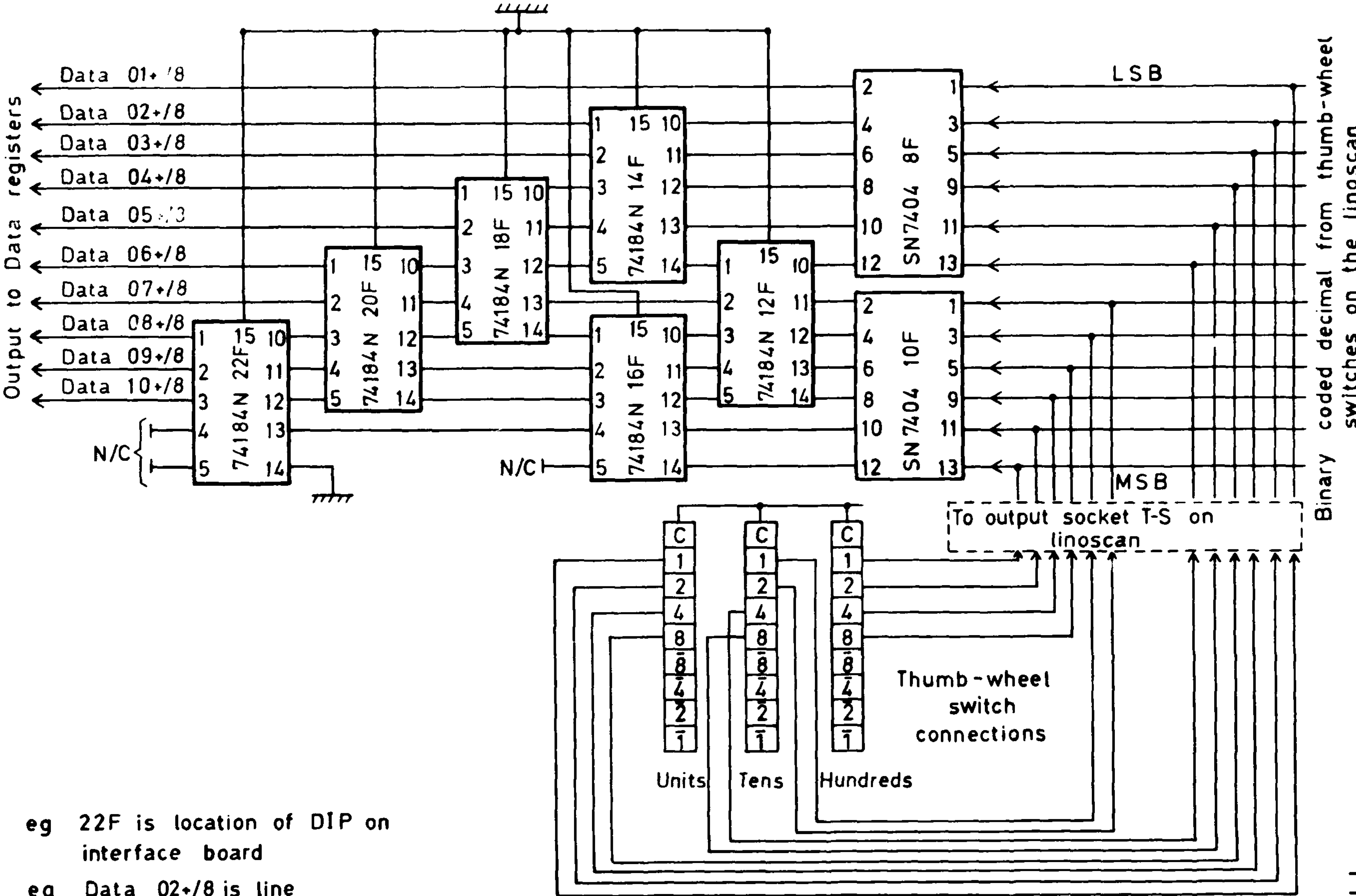


Fig 8 Data registers

T Memo Space 282

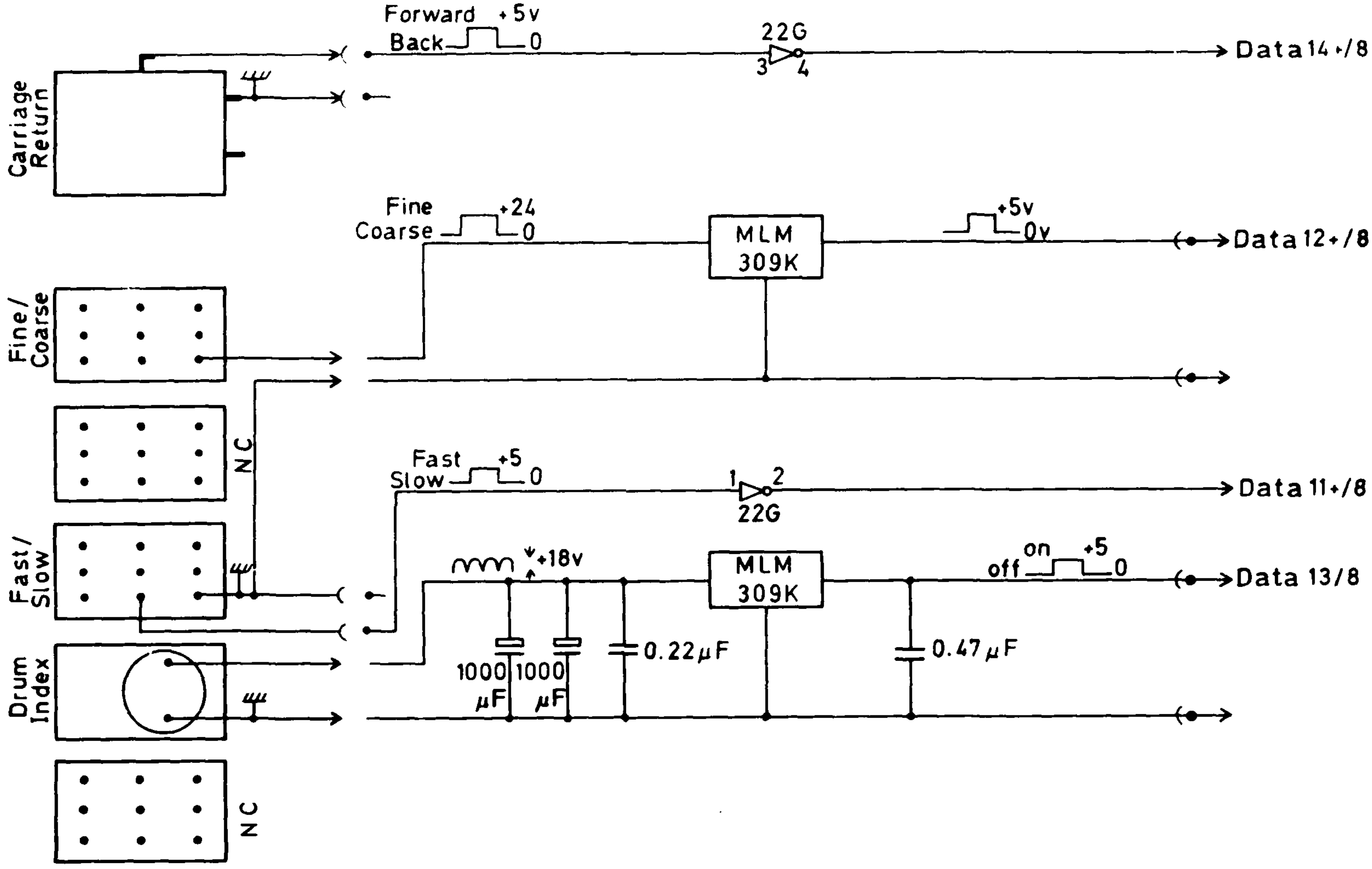


eg 22F is location of DIP on interface board

eg Data 02+/8 is line Data 02+ Fig. 8

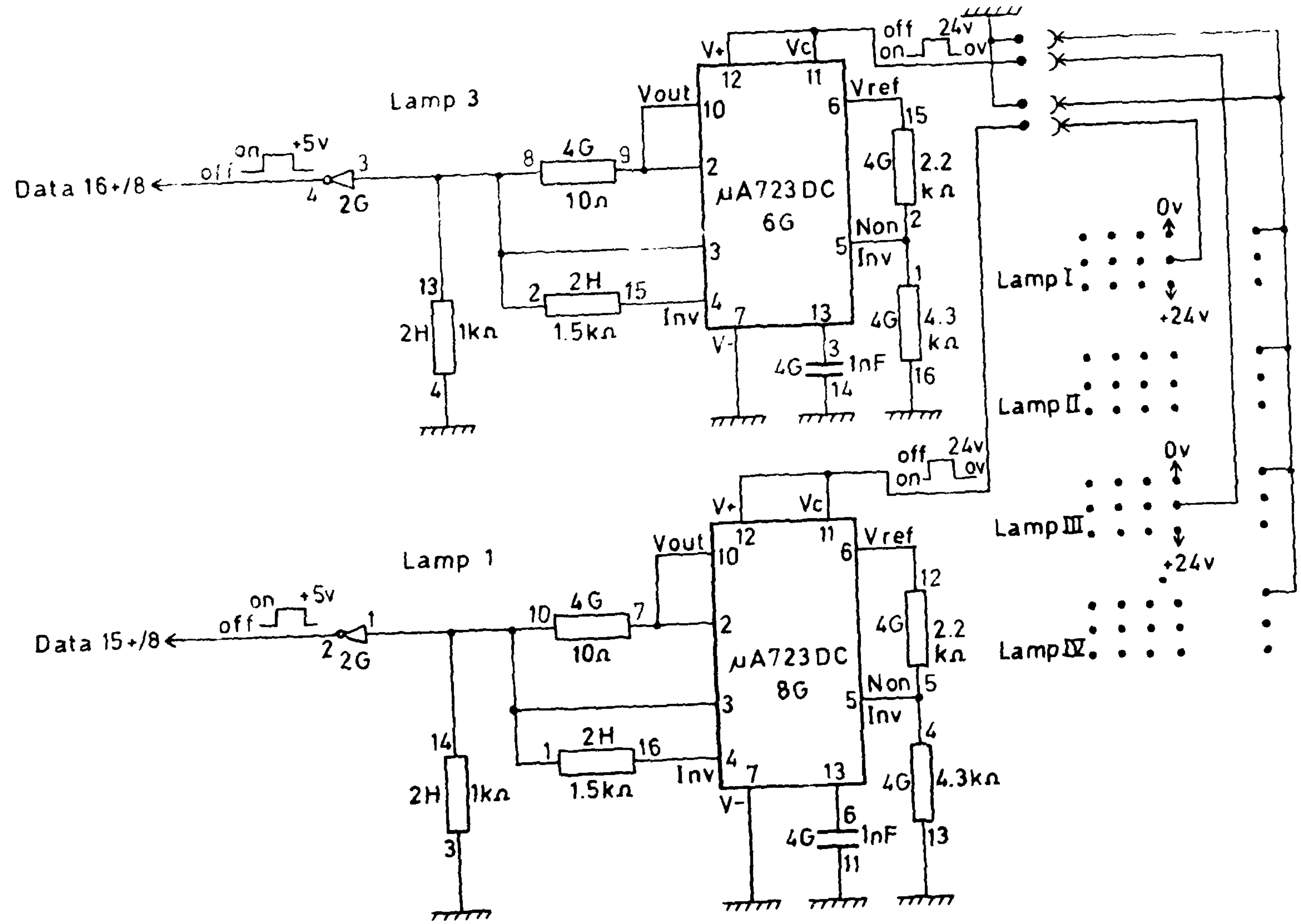
Fig. 9 BCD to binary converter

Fig 9



eg Data 14+/8 is line Data 14+ Fig.8

Fig.10 Status switches and voltage level converters



eg 8G is location of *DIP* on interface board

eg Data 16+/8 is line Data 16+ Fig. 8

Fig. 11 Voltage level converters and lamp connections

Fig 11

Fig 12

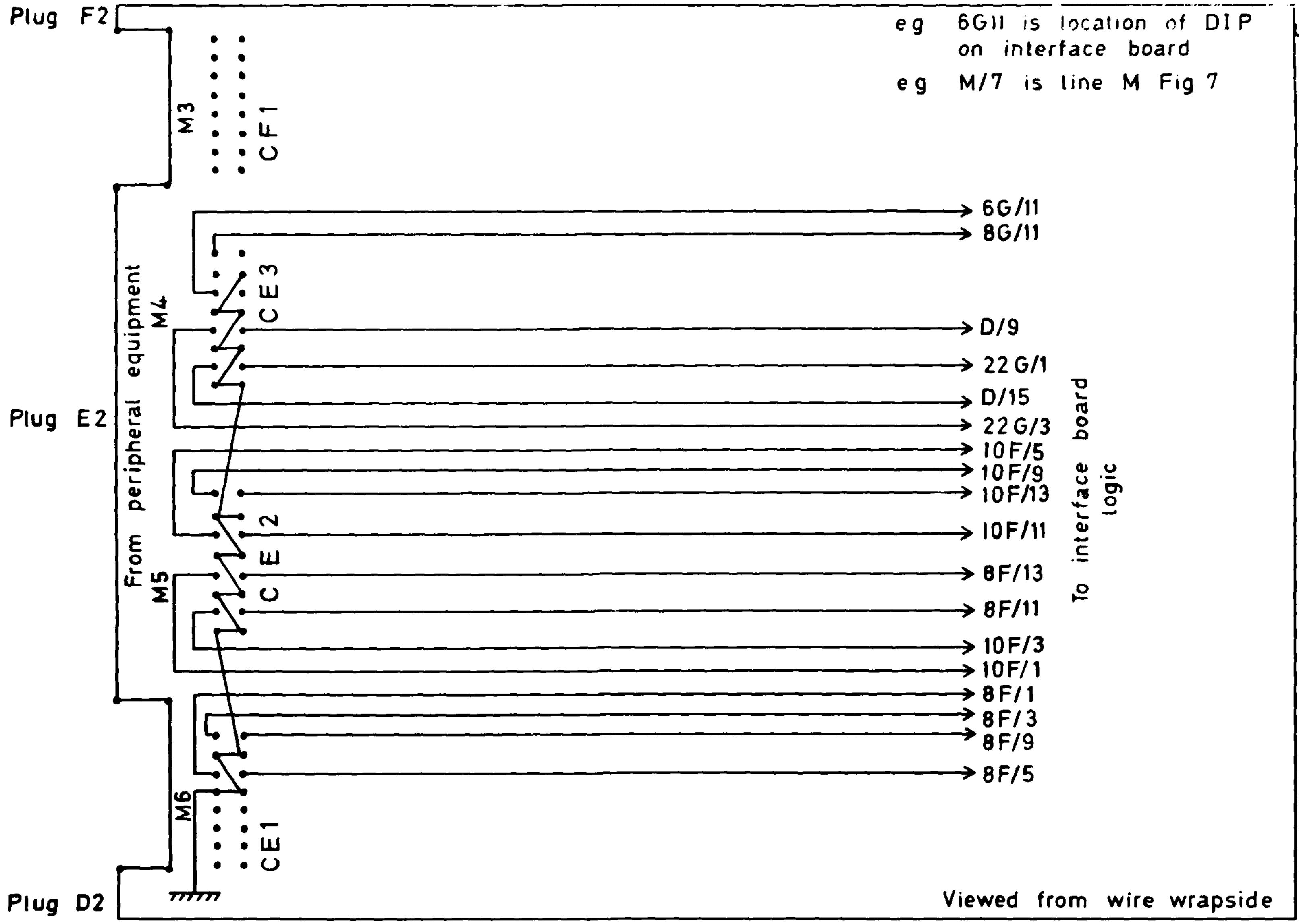


Fig. 12 GPIB plug connections

REPORT DOCUMENTATION PAGE

Overall security classification of this page

UNCLASSIFIED

As far as possible this page should contain only unclassified information. If it is necessary to enter classified information, the box above must be marked to indicate the classification, e.g. Restricted, Confidential or Secret.

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17. Abstract

The design of a computer interface board is described, which monitors and controls the operational status of a modified Linoscan 204 scanner/generator, used in the production of photographic images from data stored on computer compatible tapes.

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DAT
FILM